Rockwell-Downey Mission Support Room (MSR) and Data Display & Review (DDR) Room Upgrade

Ground Support System Methodology and Architecture

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Synergistic Approach to Systems Test and Support
Building Block Architecture Provides Transportability of Data, Procedures and Knowledge
Synergistic Approach Lowers Cost and Risk for Life Cycle of a Program

Determination of Design Errors at the Earliest Phase Reduces Cost of Vehicle Ownership
Distributed Scaleable Architecture is Based on Industry Standards Maximizing Transparency and Maintainability

- Data Base Driven
- Commercial Off-the-Shelf Hardware and Software
- Integrated Vehicle and Launch Architecture Synergism
- Distributed, Remote Processing
- Compatible with Emerging Government and Industry Systems
- Distributed, Networked and Real-Time Systems
- Expert Systems Applications to Real-Time and Ground Systems
Autonomous Control Structure Provides for Distributed and Segmented Systems

System is Completely Core Compatible
Control of Interfaces Maximizes Compatibility and Re-Use Reducing Long-Term Program Cost

Test Bed

UUT

Interface Test Adapter

Hardware Interface

Simulators

CPU
Non-Specific

Operations Environment (System Language)

Data

Content & Architecture

System Allows for Use of Multiple Vendor Hardware Platforms

User

Controlled Interfaces
Intelligent Data Management Architecture Reduces Analysis Time and Cost (Automation)

Graphics Processing
- Plots & Tables

Data Acquisition Processing
- Data Reduction
- Data Acquisition
  - Real-Time Data Monitor
  - Real-Time Data Collector

Ground Data Processing
- Raw Data
  - Data Stream

Data Supplier

Expert System
- Performance Assessment
- Multi-Level Trend Analysis
- Report Generation

Automated Data Mgmt
- Acquisition & Reduction Control
- DBMS
- Document
- User

Archival Data System

Data
- Manufacturing
- Integration
- Test Operations
- Operational Support
- Simulation

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Space Systems Division

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RI-ASSTC is Putting the System Architecture to Action
Shuttle Mission Support Room (MSR)
Data Display and Review (DDR) Room
MSR and DDR Applying Systems Concepts To Shuttle Support

- **Member of Emergency Mission Control Center (EMCC)**
  - MILA Data Link Independent from JSC

- **Real-Time Monitoring of the Vehicle During Mission & Pre/Post-Launch**
  - Provides Subsystem Engineers Visibility on Vehicle Performance
  - Processing of Two Vehicles Simultaneously
  - Real-time Data Processing and Displays
  - Post Processing

- **Currently Upgrading Workstation Architecture**
  - Architecture has Front End Processor, Server, and User Workstations
  - Rehost of MEWS Software from MER on Sun 4 for Use in Downey
  - Dataview Display Builder for User Configurable Displays
Shuttle Checkout and Mission Support Data Link

Provides Real-Time Integrated Satellite/Ground Systems
MSR/DDR Upgrade System Architecture Enables Greater Mission Support Capabilities
Expert Systems Enhance the DD&R Room Flight Support

- Improves Effectiveness of Subsystem Engineers
- Faster, More Accurate Malfunction Diagnosis
- Increased Safety
- Expert Knowledge Captured and On-Line
- Reduced Training Costs
  - Both Expert and Trainee
  - Rockwell OMS Ground Estimates 50% Savings
- Generic Architecture Can Support Multiple Programs
- Has been Used and Demonstrated to be Effective
ASSTC is Applying ES Technology to Mission Support

- **LIFTOFF/ASCENT**
  - Abort Region Determinator
  - SSME

- **PRELAUNCH**
  - OMS Prelaunch Monitor
  - SSME Expert System

- **Flight Anomaly Manager ES**

- **ON ORBIT**
  - OMS Burn Monitor
  - MPS
  - EPD&C

- **Flight Anomaly Manager (FAM)**

- **DEORBUT/LANDING**
  - OMS Burn Monitor

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FAM Interprets Output of Subsystem Expert System

SHUTTLE

DATA LINK

DECOM

DATA SERVER

SUB-SERVERS

MSR SUB-SERVER

DD&I SUB-SERVER

OFFICE AREA SUB-SERVER

OTHER LOCATIONS

LEVEL 1

SUBSYSTEM SPECIFIC EXPERT SYSTEMS

LEVEL 2

CRITICAL FUNCTION AUDIT

- ELEMENT INTERACTION
- SUBSYSTEM INTERACTION
- FAILURE SCENARIO
- RECOVERY PROCEDURE

FLIGHT ANOMOLY MANAGER EXPERT SYSTEM (FAM)

RECOMMENDATIONS TO MANAGEMENT

DATA BASE

- FLIGHT RULES
- MISSION RQTS
- SPECS
- HANDBOOK
- NASA & FI TECH EXPERTS

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Flight Anomaly Manager

- Provides Mission Support Team Leader with Overall Vehicle Status
  - Knowledgeable About Subsystem to Subsystem Interactions
  - Knows the Effect of Failure on Other Subsystems
  - Provides Management Insight into Vehicle Status
  - Makes Recommendations
  - Communicates with Subsystem Specific Expert Systems

- Multi-Layered Implementation
  - Sun Workstation Using G2
  - Communication with Subsystem Specific Expert Systems via GSI

- Interacts with Subsystem Specific Expert Systems
  - EPD&C
  - OMS
  - SSME
  - Fuel Cells
  - ECLSS
Ground Support - Summary

○ RI-SSD has Developed and Delivered a Number of "Turn Key" Systems
  - ATE
  - Simulation Support
  - Factory/Flight Line
  - Payload Integration
  - Mission Support

○ The Methodology being Used Allows for the Growth and Support of the System throughout the Life Cycle of a Program
  - Scaleable
  - Adaptable

○ The Ground System Architecture Provides for Data and Procedure Transportability throughout the Life Cycle

System Architecture Provides for Generic Application to Any Program
Background Material

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# ASSTC Laboratory Environments Support Technology & Market Evolution

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